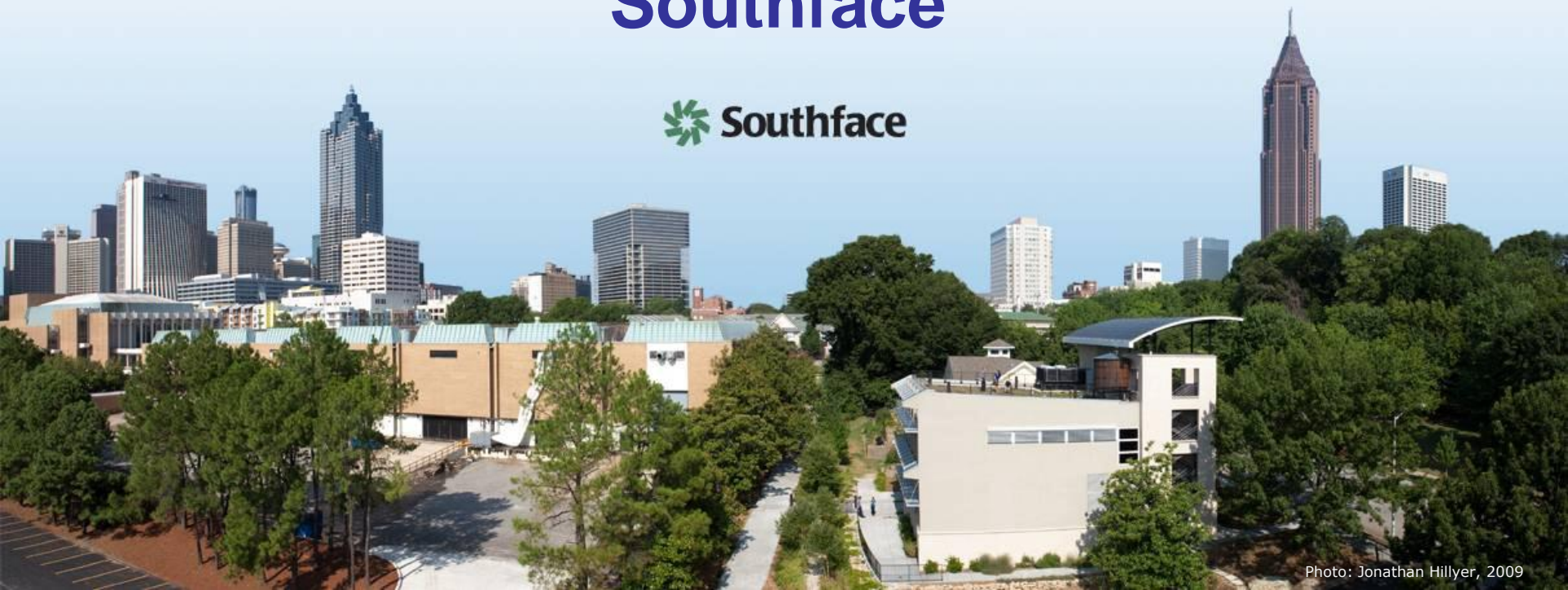


Energy Codes: IECC 2009 & IECC 2012 What Are The Big Changes?

Mike Barcik
Southface



- Training
- Green Building: EarthCraft, LEED
- Building Audits & Assessments
- Charrettes
- Sustainability Planning
- Affordable Housing
- Modeling
- Code Education & Advocacy



Photo:

Jonathan
Hillyer
2009





GREENPRINTS

Green Building Conference

March 7-8, 2012

Georgia Tech Research Institute
Atlanta, Georgia

Save the Date

March 7-8, 2012

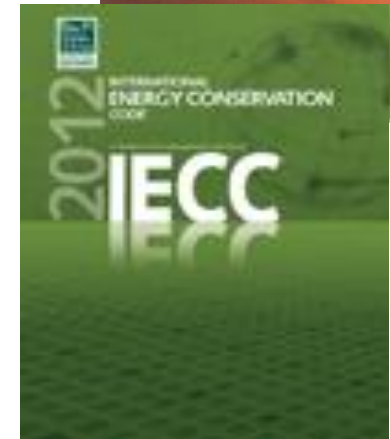
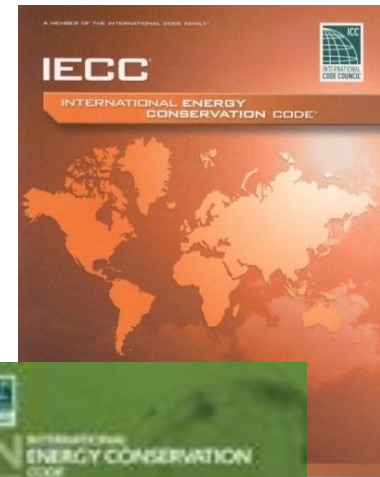
www.greenprints.org

Hosted by  Southface



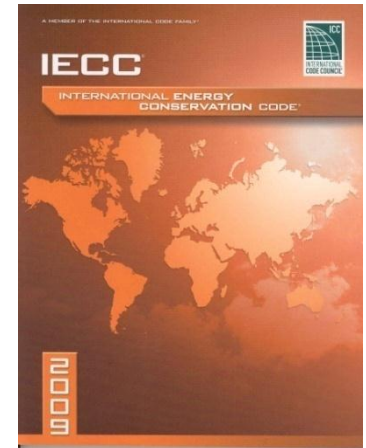
Importance of Energy Codes

- **Saves energy** - Buildings consume 40% of energy in U.S.; energy codes reduce dependence on foreign energy sources
- **Saves money**- energy costs continue to escalate and energy codes help keep money within local economy
- **Additional benefits:**
 - Increases comfort, health and durability of homes
 - Increases value of homes in local community
 - Reduces liability for builder and subcontractors



History of Energy Codes

- MEC 1992, '93, 95 – “Early” energy codes, complicated, DP windows required
- IECC 98, 2000, '03 – “Strengthening”, SHGC of 0.4 required where < 3500 HDD
- IECC 2004, '06 – “Simplification”, Fewer CZ’s, eliminate % glazing, certificate required
- IECC 2009 – Duct + envelope testing, efficient lighting – ARRA “mandated”
- IECC 2012 – More challenging than ever!
- The code keeps raising the bar (typically 1-3%) until more recently!
 - '09 Code is ~15% more stringent than '06 version
 - '12 Code is ~30% more stringent than '06 version
 - '15 Code target is 50% > than '06 version



Summary of Changes to IECC 2012

- ~30% better than IECC 2006
- Major changes
 - Consolidated with IRC energy chapter (actually a change to the IRC, not the IECC)
 - Mandatory whole-house pressure test
 - More stringent duct leakage test
 - DHW distribution system requirements
- Minor changes
- Key non-changes
 - Retains prohibition on envelope-equipment trade-offs
 - Makes lighting requirements “mandatory”



Commercial Section

- Ch. 1 Scope, Application, Administrative and Enforcement
- Ch. 2 Definitions
- Ch. 3 General Requirements
- Ch. 4 **Commercial Energy Efficiency**
- Ch. 5 Referenced Standards
- Index



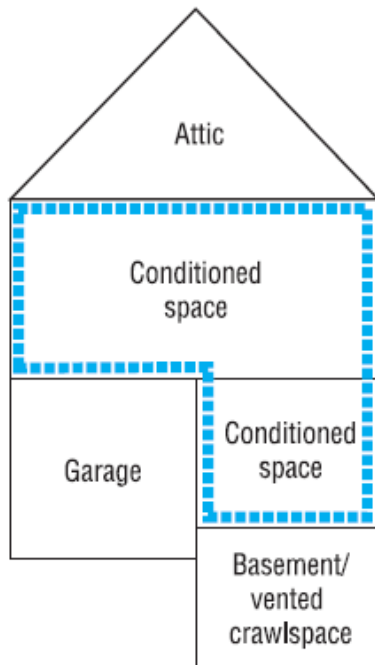
Residential Section

- Ch. 1 Scope and Application / Administrative and Enforcement
- Ch. 2 Definitions
- Ch. 3 General Requirements
- Ch. 4 **Residential Energy Efficiency**
- Ch. 5 Referenced Standards
- Index

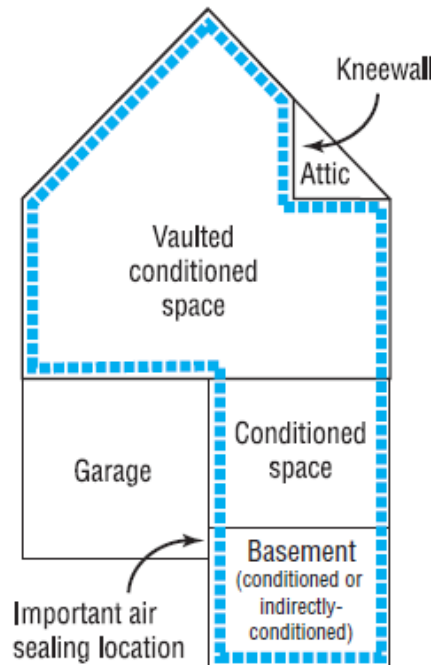
402-Building Thermal Envelope

The *building thermal envelope* is the barrier that separates the conditioned space from the outside or unconditioned spaces. The building envelope consists of two parts - an air barrier and a thermal barrier that must be both continuous and contiguous (touching each other). In a typical residence, the building envelope consists of the roof, walls, windows, doors, and foundation. Examples of unconditioned spaces include attics, vented crawlspaces, garages, and basements with ceiling insulation and no HVAC supply registers.

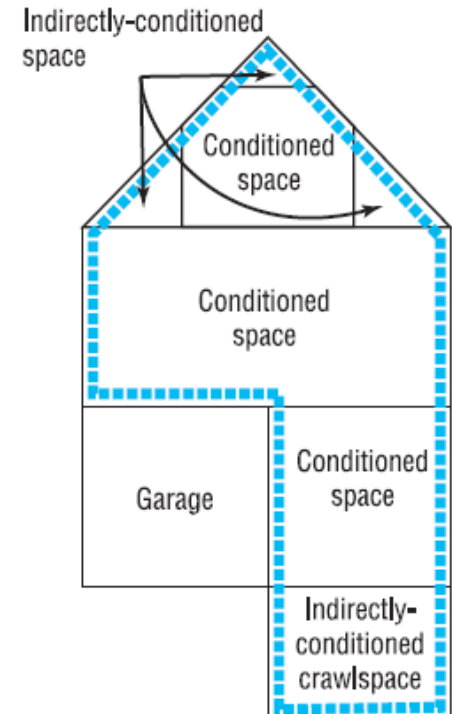
Example 1



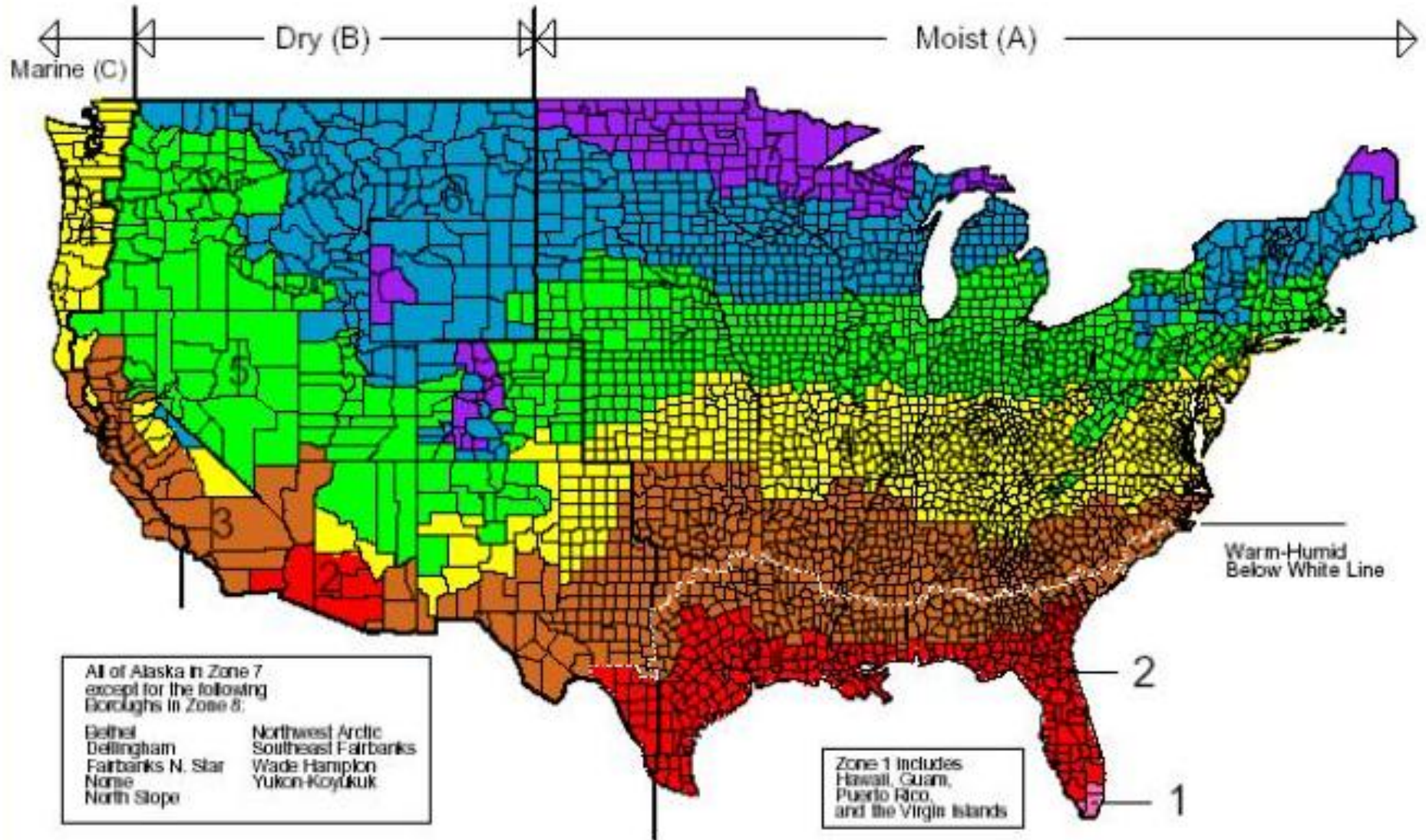
Example 2

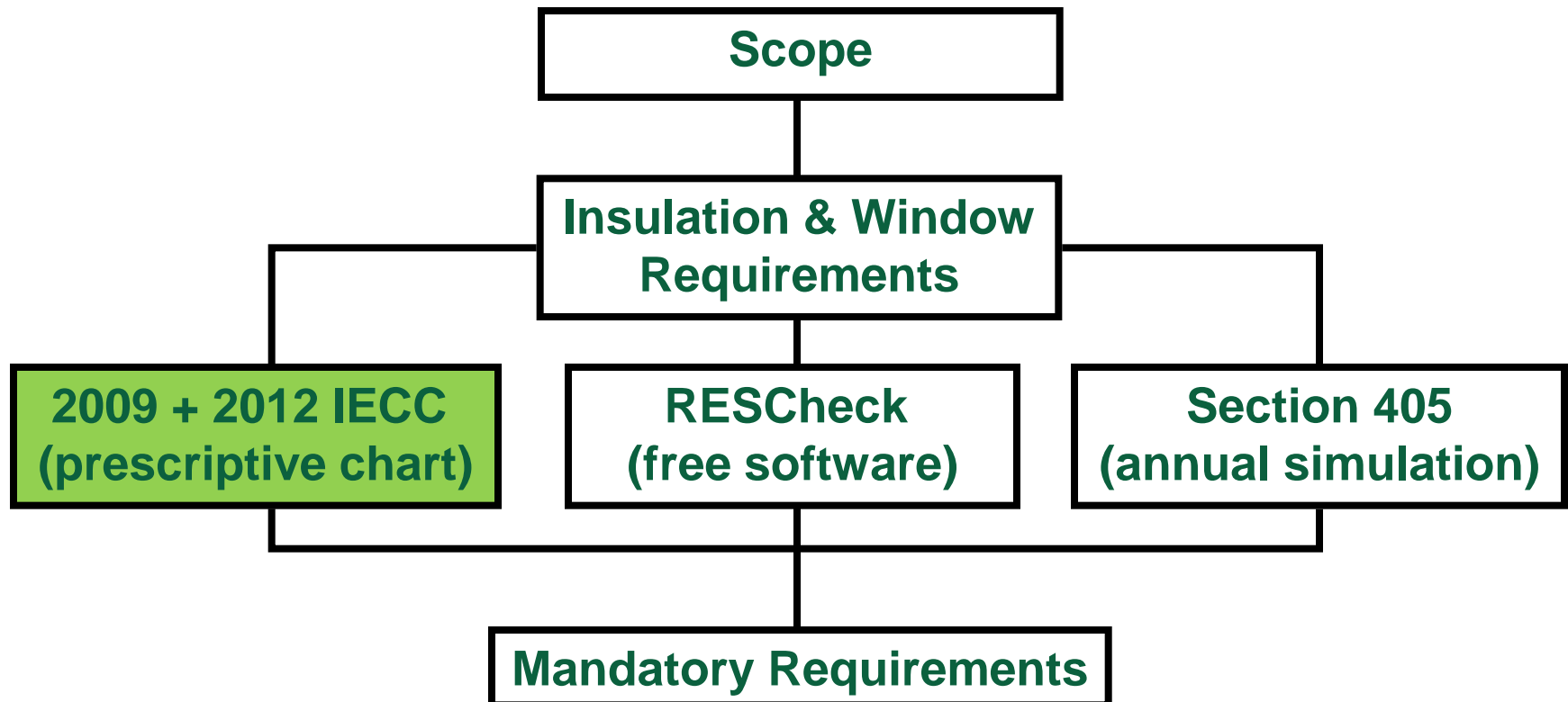


Example 3

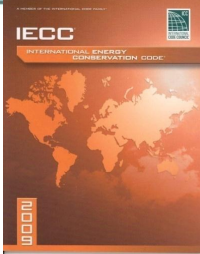


IECC Climate Zones





Insulation & Fenestration by Climate Zone



**Table 402.1.1
Insulation and Fenestration Requirements by Component^a**

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION ^{b,e} SHGC	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE ⁱ	FLOOR R-VALUE	BASEMENT ^c WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^c WALL R-VALUE
1	1.20	0.75	0.30	30	13	3 / 4	13	0	0	0
2	0.65 ^j	0.75	0.30	30	13	4 / 6	13	0	0	0
3	0.50 ^j	0.65	0.30	30	13	5 / 8	19	5 / 13 ^f	0	5 / 13
4 except Marine	0.35	0.60	NR	38	13	5 / 10	19	10 / 13	10, 2ft	10 / 13
5 and Marine 4	0.35	0.60	NR	38	20 or 13+5 ^h	13 / 17	30 ^g	10 / 13	10, 2 ft	10 / 13
6	0.35	0.60	NR	49	19 or 13+5 ^h	15 / 19	30 ^g	15 / 19	10, 4 ft	10 / 13
7 and 8	0.35	0.60	NR	49	21	19 / 21	38 ^g	15 / 19	10, 4 ft	10 / 13

^a *R*-values are minimums, *U*-factors and SHGC are maximums, R-19 batts compressed into a nominal 2 x 6 framing cavity such that the *R*-value is reduced by R-1 or more shall be marked with the compressed batt *R*-value in addition to the full thickness *R*-value.

^b The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

^c "15/19" means R-15 continuous insulated sheathing on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulated sheathing on the interior or exterior of the home. "10/13" means R-10 continuous insulated sheathing on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.

^d R-5 shall be added to the required slab edge *R*-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Zones 1 through 3 for heated slabs.

^e There are no SHGC requirements in the Marine Zone.

^f Basement wall insulation is not required in warm-humid locations as defined by Figure 301.1 and Table 301.1.

^g Or insulation sufficient to fill the framing cavity, R-19 minimum.

^h "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25 percent or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.

ⁱ The second *R*-value applies when more than half the insulation is on the interior of the mass wall.

^j For impact rated fenestration complying with Section R301.2.1.2 of the *IRC* or Section 1608.1.2 of the *IBC*, maximum *U*-factor shall be 0.75 in Zone 2 and 0.65 in Zone 3.

Insulation & Fenestration by Climate Zone



**TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT***

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b,*}	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE ^e	FLOOR R-VALUE	BASEMENT ^c WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^c WALL R-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5 ^b	8/13	19	5/13 ^f	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 ^b	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5 ^b	13/17	30 ^g	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10 ^h	15/20	30 ^g	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10 ^h	19/21	38 ^g	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

- R*-values are minimums. *U*-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall not be less than the *R*-value specified in the table.
- The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration. Exception: Skylights may be excluded from glazed fenestration SHGC requirements in Climate Zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.
- "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.
- R-5 shall be added to the required slab edge *R*-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.
- There are no SHGC requirements in the Marine Zone.
- Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.
- Or insulation sufficient to fill the framing cavity, R-19 minimum.
- First value is cavity insulation, second is continuous insulation or insulated siding, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation *R*-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used – to maintain a consistent total sheathing thickness.
- The second *R*-value applies when more than half the insulation is on the interior of the mass wall.

**TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENT**

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b, c}	CEILING R-VALUE	WOOD FRAME WALL R-VALUE
1	NR	0.75	0.25	30	13
2	0.40	0.65	0.25	38	13
3	0.35	0.55	0.25	38	20 or 13+5 ^b
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 ^b
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5 ^b
6	0.32	0.55	NR	49	20+5 or 13+10 ^b
7 and 8	0.32	0.55	NR	49	20+5 or 13+10 ^b

h. First value is cavity insulation, second is continuous insulation or insulated siding, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation R-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used – to maintain a consistent total sheathing thickness.

Steel

Framing – R402.2.6

TABLE R402.2.6
STEEL-FRAME CEILING, WALL AND FLOOR INSULATION
(R-VALUE)

WOOD FRAME R-VALUE REQUIREMENT	COLD-FORMED STEEL EQUIVALENT R-VALUE ^a
Steel Truss Ceilings^b	
R-30	R-38 or R-30 + 3 or R-26 + 5
R-38	R-49 or R-38 + 3
R-49	R-38 + 5
Steel Joist Ceilings^b	
R-30	R-38 in 2 × 4 or 2 × 6 or 2 × 8 R-49 in any framing
R-38	R-49 in 2 × 4 or 2 × 6 or 2 × 8 or 2 × 10
Steel-Framed Wall 16" O.C.	
R-13	R-13 + 4.2 or R-19 + 2.1 or R-21 + 2.8 or R-0 + 9.3 or R-15 + 3.8 or R-21 + 3.1
R-13 + 3	R-0 + 11.2 or R-13 + 6.1 or R-15 + 5.7 or R-19 + 5.0 or R-21 + 4.7
R-20	R-0 + 14.0 or R-13 + 8.9 or R-15 + 8.5 or R-19 + 7.8 or R-19 + 6.2 or R-21 + 7.5
R-20 + 5	R-13 + 12.7 or R-15 + 12.3 or R-19 + 11.6 or R-21 + 11.3 or R-25 + 10.9
R-21	R-0 + 14.6 or R-13 + 9.5 or R-15 + 9.1 or R-19 + 8.4 or R-21 + 8.1 or R-25 + 7.7
Steel Framed Wall, 24" O.C.	
R-13	R-0 + 9.3 or R-13 + 3.0 or R-15 + 2.4
R-13 + 3	R-0 + 11.2 or R-13 + 4.9 or R-15 + 4.3 or R-19 + 3.5 or R-21 + 3.1
R-20	R-0 + 14.0 or R-13 + 7.7 or R-15 + 7.1 or R-19 + 6.3 or R-21 + 5.9
R-20 + 5	R-13 + 11.5 or R-15 + 10.9 or R-19 + 10.1 or R-21 + 9.7 or R-25 + 9.1
R-21	R-0 + 14.6 or R-13 + 8.3 or R-15 + 7.7 or R-19 + 6.9 or R-21 + 6.5 or R-25 + 5.9
Steel Joist Floor	
R-13	R-19 in 2 × 6, or R-19 + 6 in 2 × 8 or 2 × 10
R-19	R-19 + 6 in 2 × 6, or R-19 + 12 in 2 × 8 or 2 × 10

a. Cavity insulation R-value is listed first, followed by continuous insulation R-value.

b. Insulation exceeding the height of the framing shall cover the framing.



**TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COM**

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b, c}	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE ^d
1	NR	0.75	0.25	30	13	3/4
2	0.40	0.65	0.25	38	13	4/6
3	0.25	0.55	0.25	38	20 or 13+5 ^e	8/13
4 except Marine					or 13+5 ^e	8/13
5 and Marine 4					or 13+5 ^e	13/17
6					or 13+10 ^h	15/20
7 and 8					or 13+10 ^h	19/21

Second (higher) number applies when more than half the R-value is on the interior of the mass (i.e., when the thermal mass is insulated from the conditioned space)

Foundation Walls



Zone	Basement Wall R-Value	Crawlspace Wall R-Value
1		
2		
3		
4 except Marine		
5 and Marine 4	R10/13 → R15/19	
6		R10/13 → R15/19
7 & 8		

Prescriptive Code: Major Shell Changes



Zone	Ceiling R-Value	Wood-Frame Wall R-Value	Mass Wall R-Value
1			
2	R30 → R38		
3		R13 → R20/R13+5	R5/8 → R8/13
4 except Marine	R38 → R49		
5 and Marine 4			
6		R20/R13+5 → R20+5/R13+10	R15/19 → R15/20
7 & 8		R21 → R20+5/R13+10	



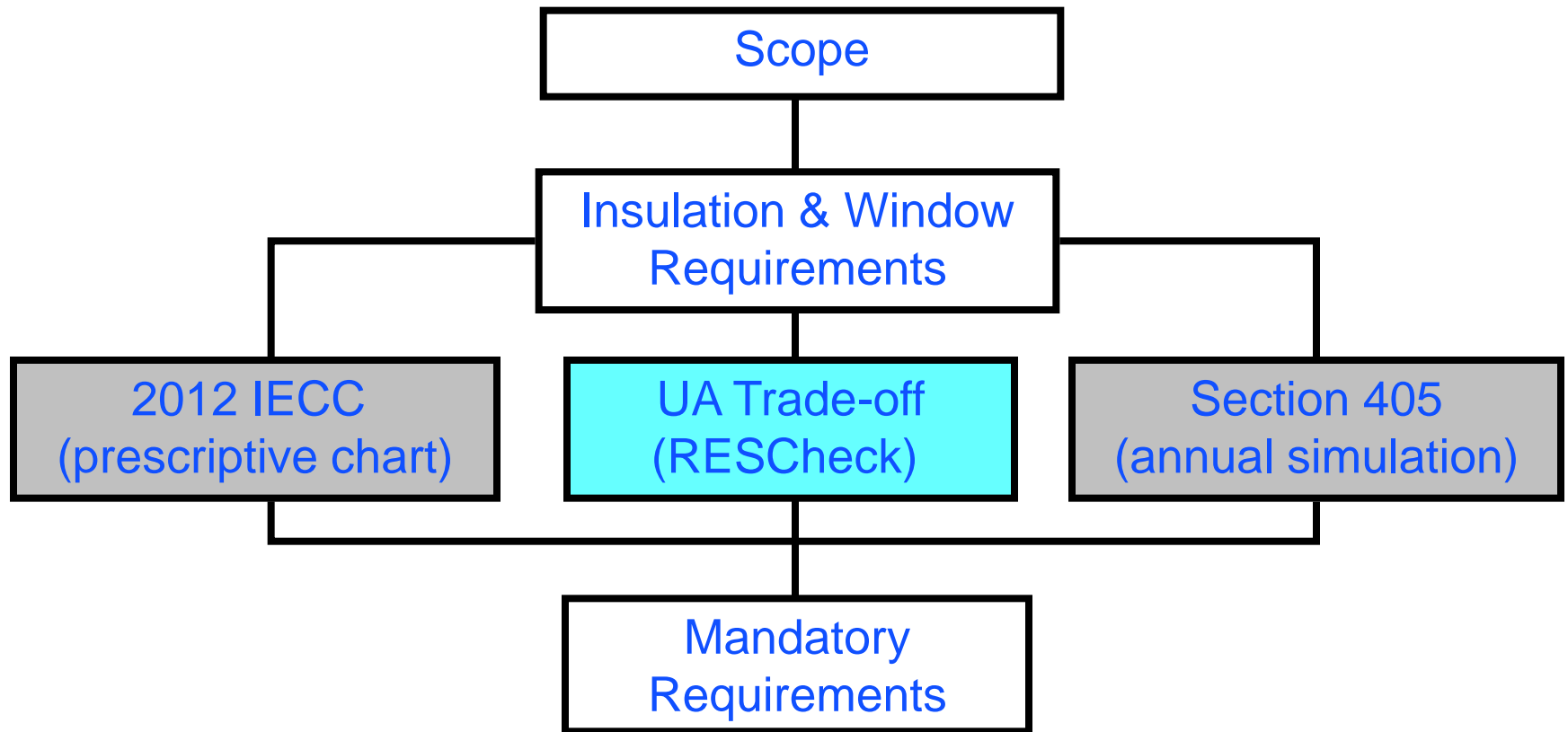
- 2x6 construction now “required” in some zones
 - Envelope trade-off options limited
 - Equipment trade-off options prohibited
- Log walls difficult to comply without large diameter logs or furred-in finish layer
- Insulating sheathing now “required” in some zones
 - Bracing options limited, especially with recent IRC changes



Prescriptive Code: Fenestration Changes

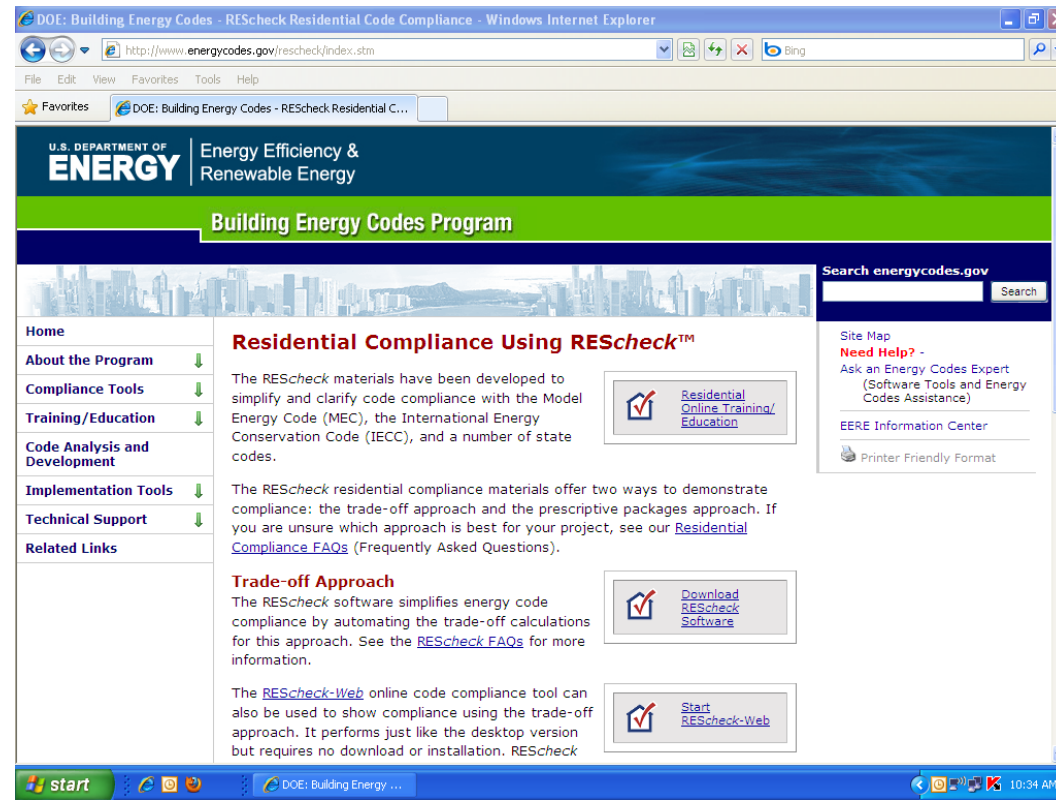
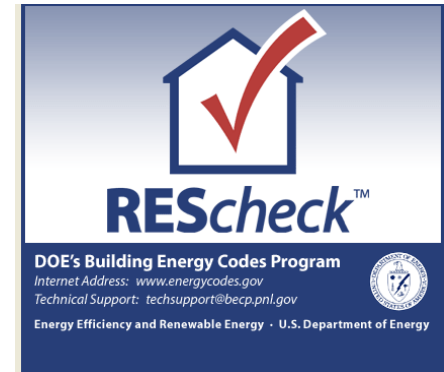


Zone	Fenestration U-Factor	Fenestration SHGC
1	1.2 → 0.50	
2	0.65 → 0.40 (0.75 → 0.65 skylights)	0.30 → 0.25 (except skylights)
3	0.50 → 0.35 (0.65 → 0.55 skylights)	
4 except Marine	(0.60 → 0.55 skylights)	NR → 0.40
5 and Marine 4		
6	0.35 → 0.32 (0.60 → 0.55 skylights)	
7 & 8		



www.energycodes.gov

- Software evaluates specific designs quickly
- Demonstrates SHGC compliance
- Allows trade-offs
 - Building envelope components
 - Heating and cooling equipment efficiency trade-offs not allowed in '09 or '12 IECC





- Vaulted ceilings and foam sprayed rooflines would likely need to perform an R-value (U-factor) trade-off
- RESCheck is an excellent free tool for this
- Still must satisfy all mandatory requirements



- Details for insulating various aspects of the building envelope
 - Ceilings with Attic – 402.2.1
 - Ceilings w/out Attic – 402.2.2
 - Eave baffle – 402.2.3
 - Access hatches and doors – 402.2.4
 - Mass Walls – 402.2.5
 - Steel Framing – 402.2.6
 - Floors – 402.2.7
 - Basement Walls – 402.2.8
 - Slab-on-grade – 402.2.9
 - Crawlspace Walls – 402.2.10
 - Masonry Veneer – 402.2.11
 - Sunrooms – 402.2.12

402.2.1 - Ceilings with Attics

- Use of advanced framing (raised top plate or energy trusses) that permit continuous, consistent R-value is credited:
- R-38->R-30; R-49->R-38
- Rulers required every 300 s.f.
- GA: R-19 acceptable under HVAC attic platforms (32 s.f./platform + 32" walkway)



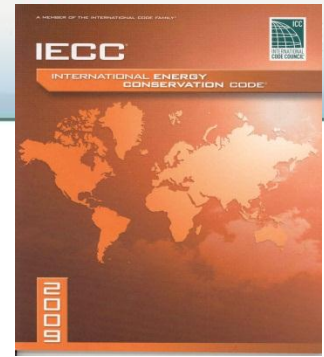
402.2.1 - Ceilings with Attics

- Tradeoff required unless entire ceiling meets prescriptive R-value (exception for 402.2)



402.2.2 - Ceilings without Attics

- All Climate Zones require at least R-30
- Up to 500 s.f. can be traded down to R-30 if the assembly does not permit room for full amount

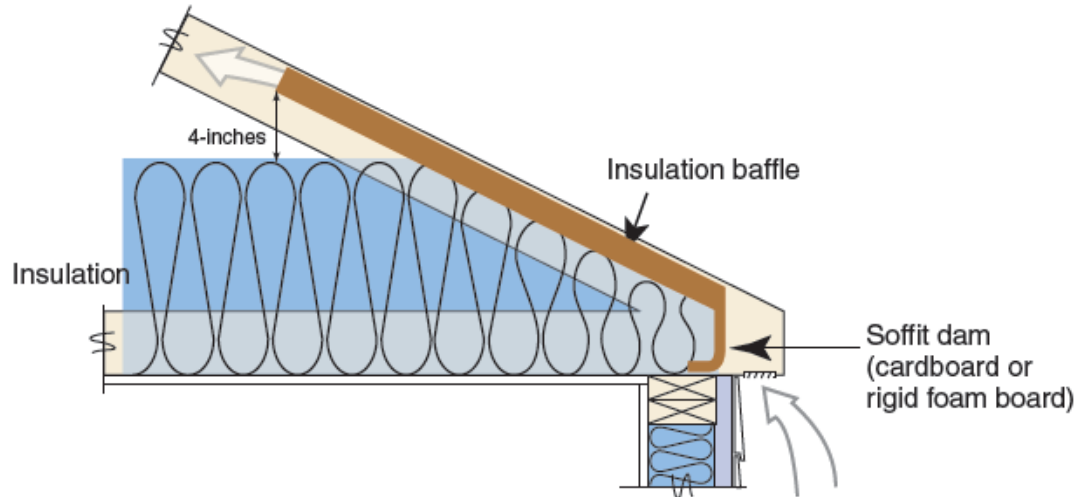


Vaulted ceilings and foam sprayed rooflines will likely need to perform a trade-off

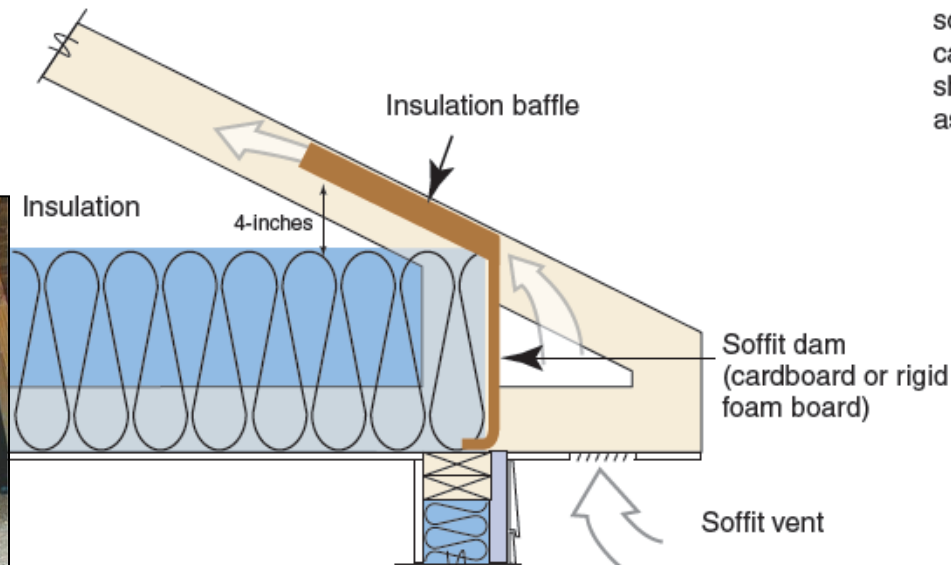
402.2.3 Eave baffle

- Details of proper eave baffle – opening \geq vent opening, solid material that extends over top of insulation

Standard Truss
with tapered
insulation depth



Energy Truss
with full height insulation
(recommended)

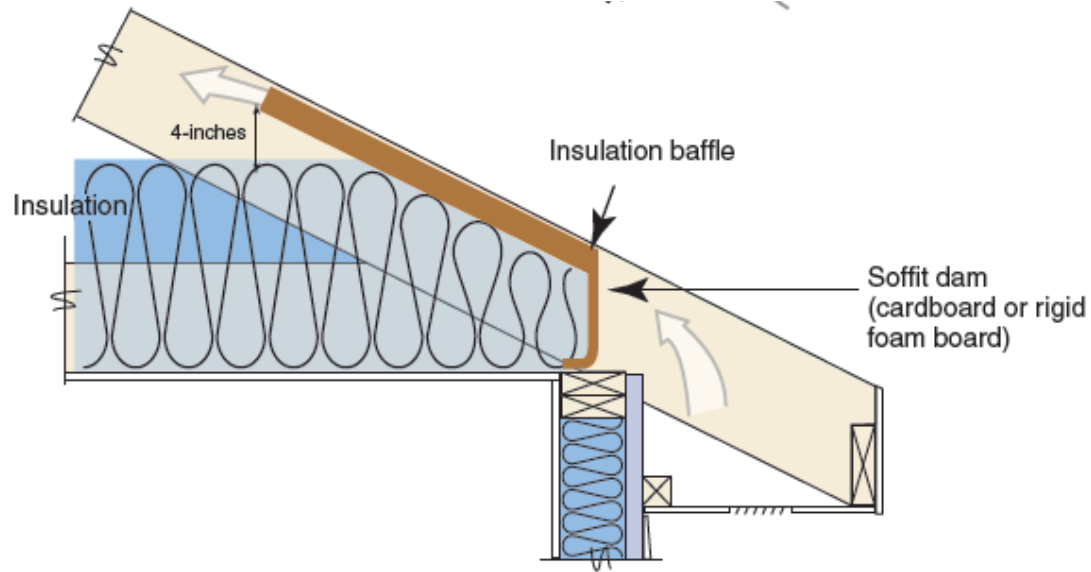


Note: Wind wash baffle and air-permeable insulation dam. For air permeable insulation in vented attics, baffles shall be installed adjacent to soffit and eave vents. A minimum of a 1-inch of space shall be provided between the insulation and the roof sheathing and at the location of the vent. The baffle shall extend over the top of the insulation inward until it is at least 4 inches vertically above the top of the insulation. Any solid material such as cardboard or thin insulating sheathing shall be permissible as the baffle.

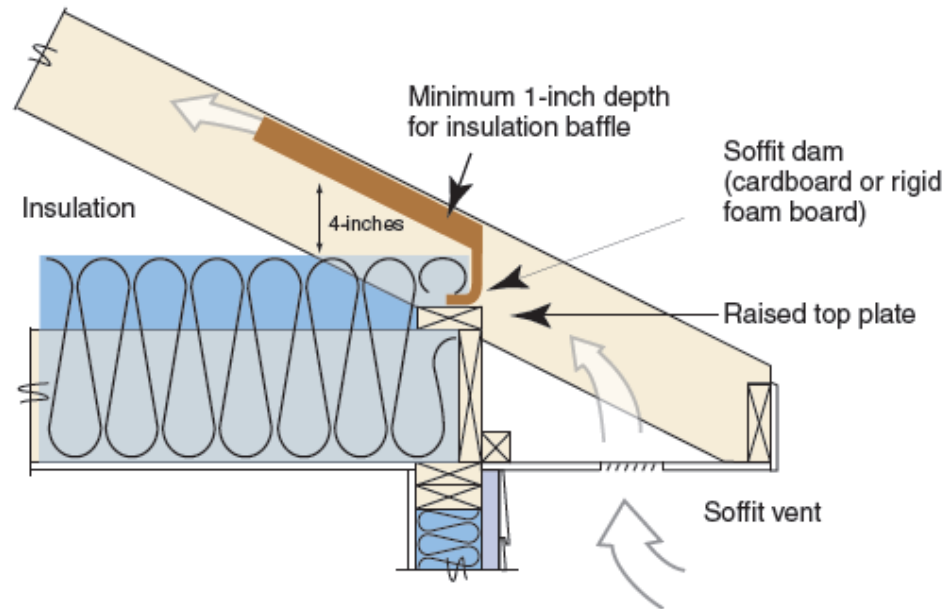


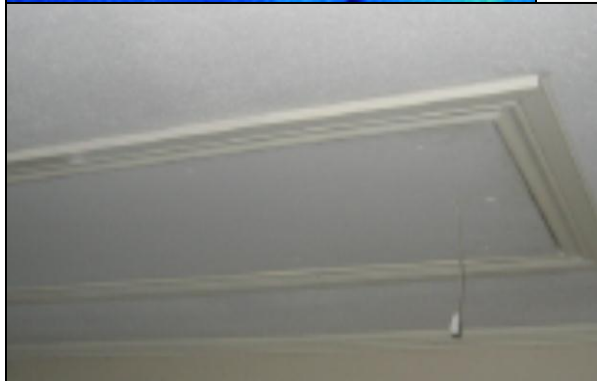
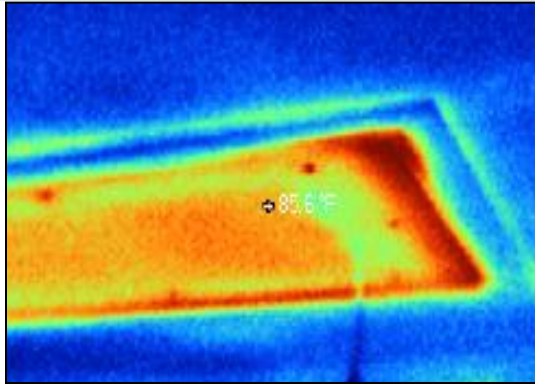
402.2.3 Eave baffle details

Standard rafter and top plate with tapered insulation depth



Rafter on raised top plate with full height insulation (recommended)





- Weather-strip and insulate access doors to match surrounding R-value
 - Vertical doors
 - Pull-down stairs
 - Hatches/scuttle holes
 - Insulation dam



402.2.5 – Mass Walls

Mass walls are above grade walls that are concrete, block, insulated concrete forms, masonry cavity, brick (other than veneer), earth (adobe, compressed block, rammed earth) and solid timber/logs

Exterior or integral insulation



CZ2: R-4, CZ3&4: R-8

Interior insulation



CZ2:R-6, CZ3&4:R-13

402.2.6 – Steel Framing

- Steel framing – equivalency charts adjust for thermal bridging (see Table)

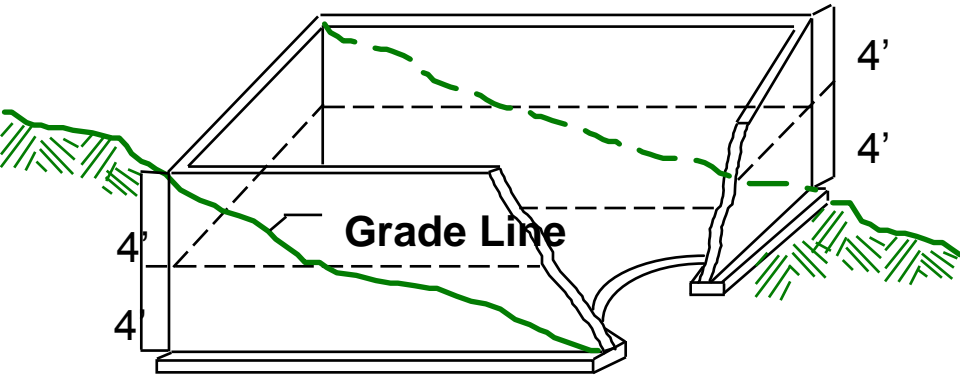


402.2.7 – Floors

- Floors – insulation must maintain (***continuous***) **permanent contact** against subfloor



402.2.8 Basement Walls



- Basement Wall – Average gross wall must be $> 50\%$ below grade and enclose conditioned space
- CZ4: R-10 continuous or R-13 cavity
- CZ3: R-5 continuous or R-13 cavity
- CZ2: No insulation required

Insulation strategies for non-finished basements:

Cellulose batt



Fiberglass batt
w/ vinyl backing

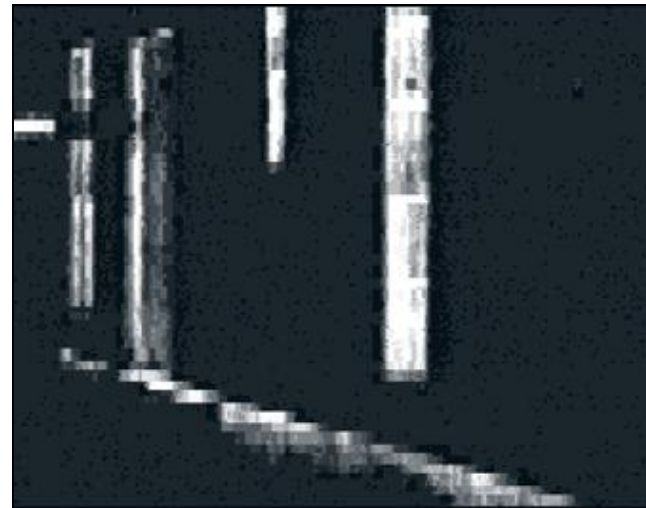


Rigid foam board

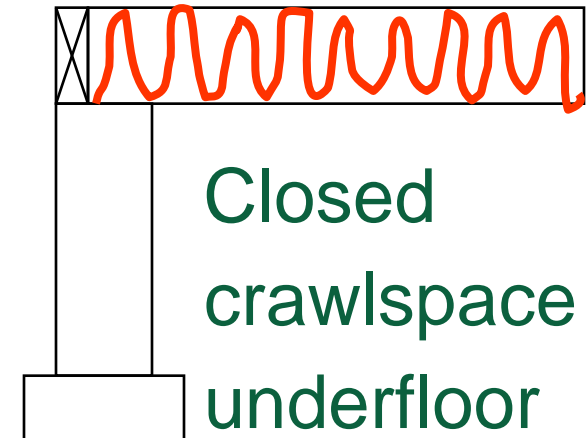
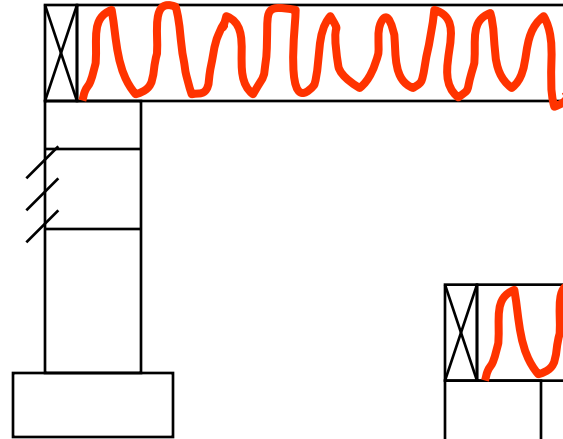


402.2.8 – Slab-on-grade

- Slabs – CZ1-3 no required insulation (termites)
- R-10 for 2' in CZ 4&5
- R-10 for 4' in CZ 6-8
- R-5 added to R-value for heated slab (e.g., radiant floor heating in slab)

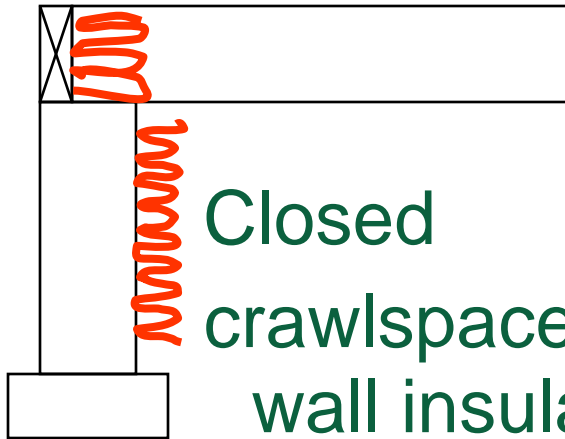


Standard vented
crawlspaces -
underfloor insulation



Closed
crawlspaces
underfloor
insulation

Closed
crawlspaces with
wall insulation



- **Note:** all crawlspaces must meet vapor retarder requirements, as per IRC

- Seal ground with plastic (6" up walls, 6" overlaps)
- Continuous insulation on interior of walls to satisfy code (R-10 in CZ4, R-5 in CZ3, R-0 in CZ2)
- Eliminate all vents and leaks (access doors)
- Satisfy IRC exception to vent requirement (2006 IRC section R408.3)

Venting Exceptions:

- Continuous exhaust (radon)
- Direct condition crawlspace (supply)
- Direct condition (dehumidifier)



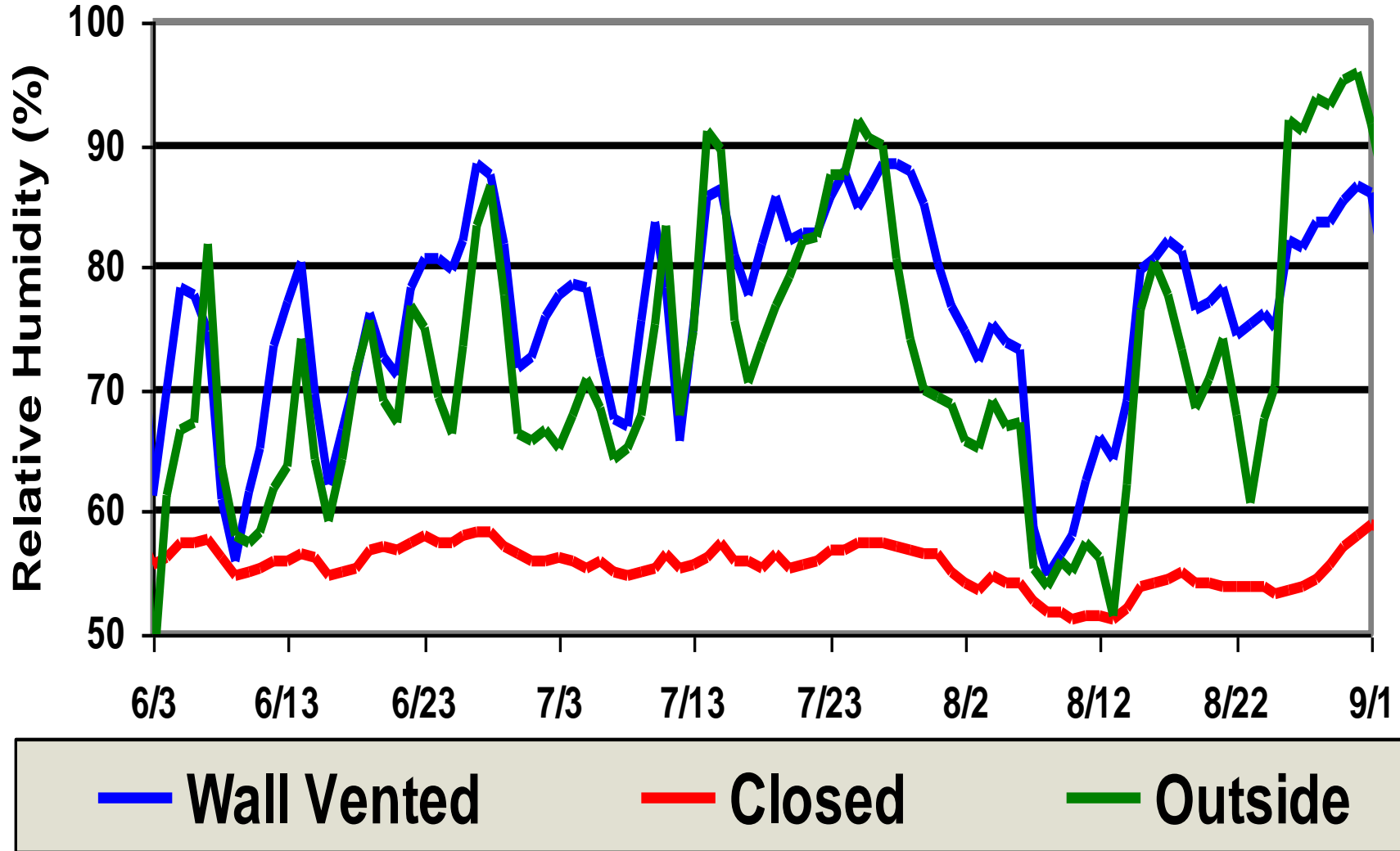
Critical Details:

- No drainage problems
- Use a sealed combustion / direct vent furnace or install a Heat Pump
- Pest Control and Code Official awareness

Crawlspace Moisture Levels

Summer 2022

www.crawlspaces.org



402.2.10 – Crawlspace Walls

402.2.10 Crawl space walls. As an alternative to insulating floors over crawl spaces, crawl space walls shall be permitted to be insulated when the crawl space is not vented to the outside. Crawl space wall insulation shall be permanently fastened to the wall and extend downward from the floor to the finished grade level and then vertically and/or horizontally for at least an additional 24 inches (610 mm). Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder in accordance with the *International Building Code*. All joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend at least 6 inches (153 mm) up the stem wall and shall be attached to the stem wall.



Reality of Underfloor Insulation

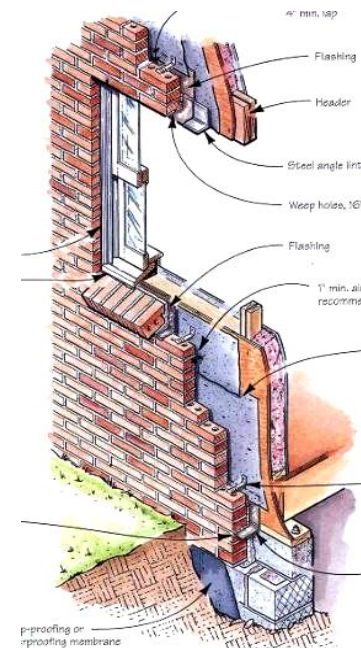


Section 402.2.11

- Masonry veneer – horizontal insulation not required (insulation exception for brick ledge)

Section 402.2.12

- Thermally Isolated Sunroom (CZ1-4: R-19 ceiling, CZ 5-8: R-24 ceiling; R-13 separation walls, fenestration meets code)



SUNROOM. A one-story structure attached to a dwelling with a glazing area in excess of 40 percent of the gross area of the structure's exterior walls and roof.

THERMAL ISOLATION. Physical and space conditioning separation from conditioned space(s). The conditioned space(s) shall be controlled as separate zones for heating and cooling or conditioned by separate equipment.

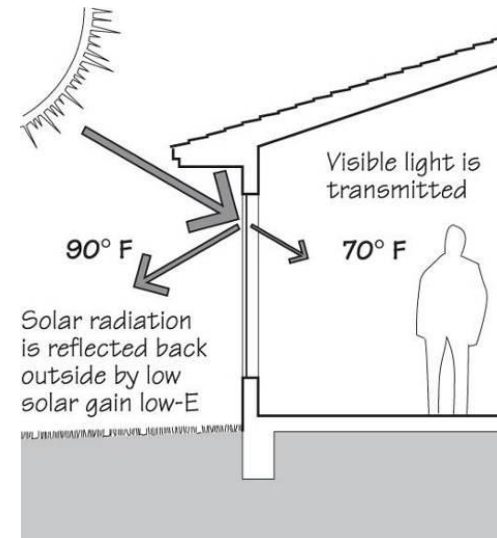
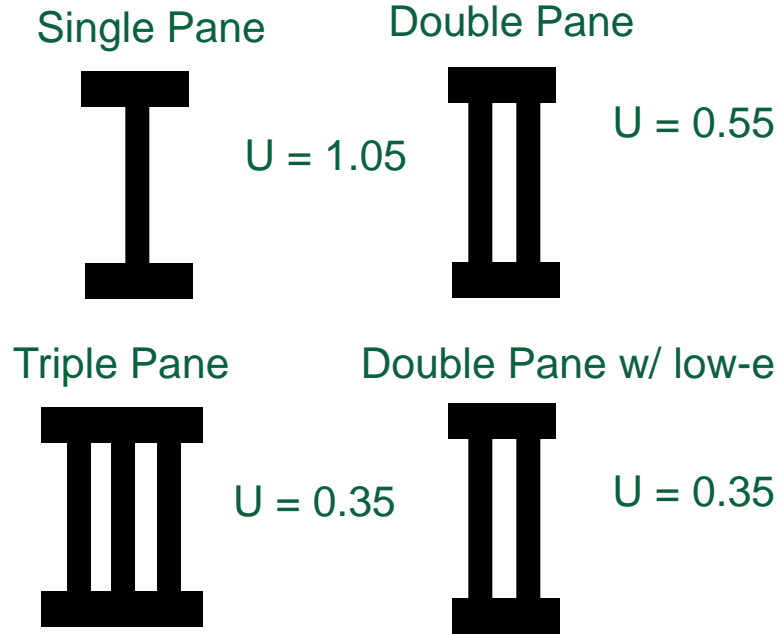


U-factor

- Lower U-factor means better insulated ($U = 1/R$)
- U-factor applies to
 - windows,
 - skylights,
 - doors

Solar Heat Gain Coefficient

- The SHGC is the fraction of the solar heat from the sun that enters through a window
 - SP clear glass
SHGC: ~ 0.8
 - DP clear glass
SHGC: ~ 0.6-0.7
 - DP low-e
(low solar gain)
SHGC: ~ 0.25

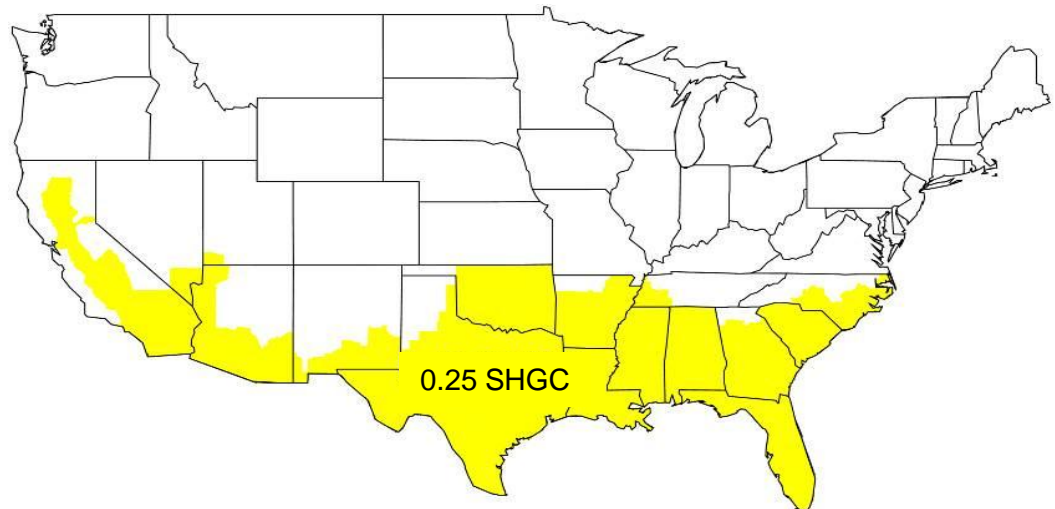


402.3 Fenestration Requirements

- **Low-e** effectively required for all CZ's!
- Maximum fenestration **U-factor** = **0.40** in CZ2, **0.35** in CZ3-4 or **0.32** in CZ 5-8
 - Area weighted average of fenestration
- Maximum **SHGC** = **0.25** for CZ1-3 and Maximum **SHGC** = **0.4** for CZ4
 - Area weighted average of fenestration

1. Show compliance by having all glazing be ≤ 0.25 (or 0.4 for CZ4)
2. Perform REScheck weighted average trade-off

 National Fenestration Rating Council® CERTIFIED	World's Best Window Co. Millennium 2000+ Vinyl-Clad Wood Frame Double Glazing • Argon Fill • Low E Product Type: Vertical Slider	
	ENERGY PERFORMANCE RATINGS	
U-Factor (U.S./I-P)	Solar Heat Gain Coefficient	
0.30	0.25	
ADDITIONAL PERFORMANCE RATINGS		
Visible Transmittance	Air Leakage (U.S./I-P)	
0.51	0.2	
<small>Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information. www.nfrc.org</small>		



402.3 Fenestration Requirements Southface

- 15 square feet exemption for decorative glazing
 - Permits modest amount of stained glass, transom windows, etc.
- Opaque door exemption
 - One opaque door is exempt from U-factor requirements
- Replacement fenestration – must meet code



303.1.3 Fenestration

If not NFRC labeled, must use tables 302.1.3 to assign a default SHGC and U-Factor



Example: vinyl-clad wood window

TABLE 303.1.3(1)
DEFAULT GLAZED FENESTRATION U-FACTOR

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

If no NFRC label present:
Default U-factor: 0.55
Default SHGC: 0.70

TABLE 303.1.3(3)
DEFAULT GLAZED FENESTRATION SHGC

SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
Clear	Tinted	Clear	Tinted	
0.8	0.7	0.7	0.6	0.6

Window Label "Catch-22"
NFRC label effectively required

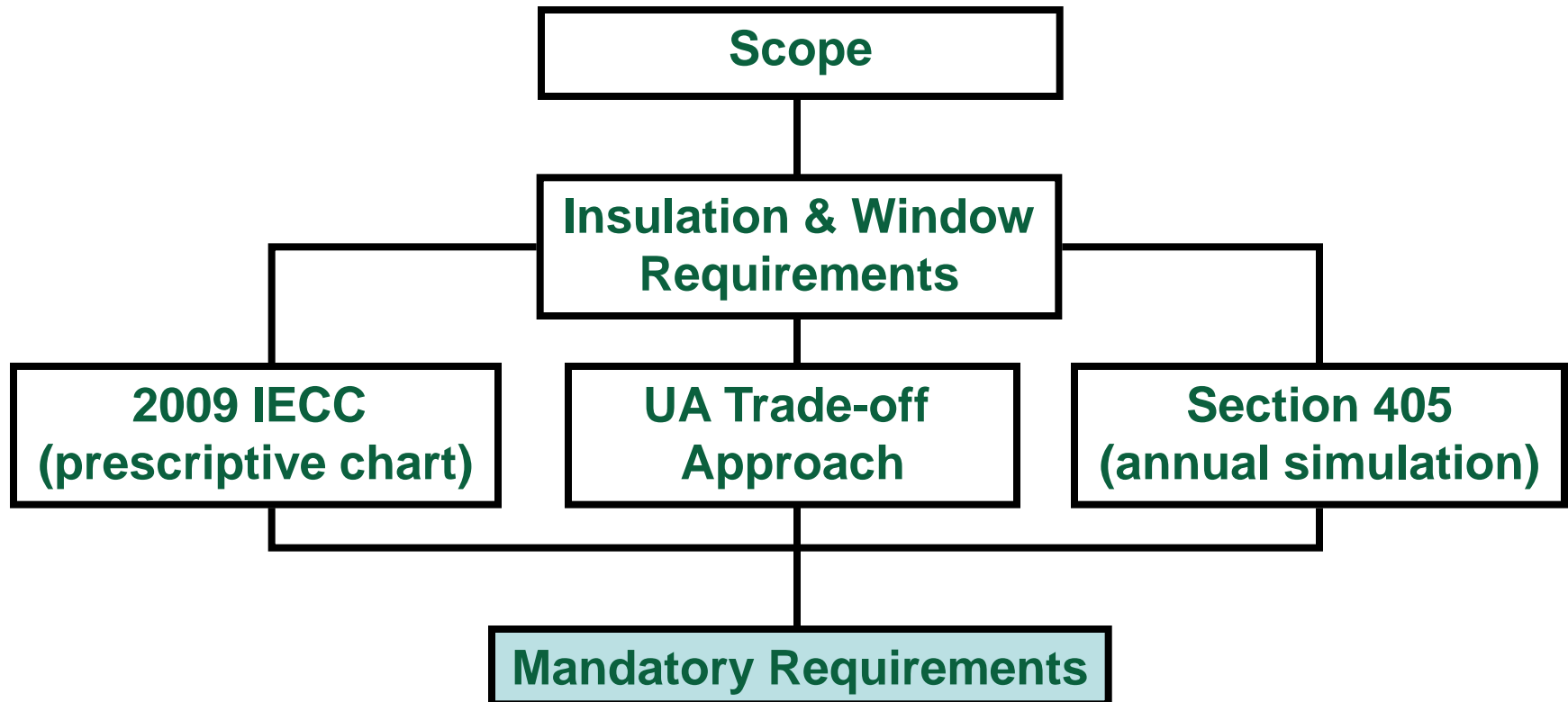
 National Fenestration Rating Council® CERTIFIED	World's Best Window Co. Millennium 2000+ Vinyl-Clad Wood Frame Double Glazing • Argon Fill • Low E Product Type: Vertical Slider	
	ENERGY PERFORMANCE RATINGS	
U-Factor (U.S./I-P) 0.30	Solar Heat Gain Coefficient 0.25	
ADDITIONAL PERFORMANCE RATINGS		
Visible Transmittance 0.51	Air Leakage (U.S./I-P) 0.2	
<small>Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information. www.nfrc.org</small>		

If NFRC label present:
Values on label apply.
(in this example:
U-factor 0.30
SHGC 0.25)

402.5 Fenestration Requirements

- If the simulated performance path (section 405) trade-offs are used, SHGC cannot exceed 0.50 (CZ 2&3) and U-factor cannot exceed 0.48 (CZ4)
- If REScheck is used, U-factor cannot exceed 0.50 and SHGC cannot exceed 0.30
- Air Leakage < 0.3 cfm / s.f. & labeled (exception for site built)

 National Fenestration Rating Council® CERTIFIED	World's Best Window Co. Millennium 2000+ Vinyl-Clad Wood Frame Double Glazing • Argon Fill • Low E Product Type: Vertical Slider	
ENERGY PERFORMANCE RATINGS		
U-Factor (U.S./I-P) 0.30	Solar Heat Gain Coefficient 0.25	
ADDITIONAL PERFORMANCE RATINGS		
Visible Transmittance 0.51	Air Leakage (U.S./I-P) 0.2	
<small>Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information. www.nfrc.org </small>		



Mandatory Requirement:

Certificate on panel box with:

- Major Component R-values
- U-factor, SHGC of Windows
- Equipment Efficiencies
- GA Specific: **Load Calculations and Envelope and Duct Testing Results**



Georgia Energy Code Compliance Certificate

House Plan: Kensington
Address: 252 Somerset Circle, Woodstock GA 30189, Lot 56
Builder: Windsong Properties, LLC Contact Information: 770-516-3409
Insulation Company: Woodman Insulation Contact Information: 770-442-9099
Heating & Air Company: D&L Heating and Air Contact Information: 770-423-3364

Envelope Information:

Flat Ceiling/Roof R-Value	R-38	Sloped/Vault Ceiling R-Value	R-38
Exterior Wall R-Value	R-13 + R-1 OSB Sheathing	(Note: R-13 + R-3 is R-13 Cavity and R-3 Sheathing)	
Attic KneeWall Cavity R-Value	R-19	Attic KneeWall Sheathing R-Value	R-1 OSB
Basement Stud Wall R-Value	N/A	Basement Continuous R-Value	N/A
Crawlspace Stud Wall R-Value	N/A	Crawlspace Continuous R-Value	N/A
Foundation Slab Edge R-Value	N/A	Above Grade Mass Wall R-Value	N/A
Cartilivered Floor R-Value	N/A	Floor Over Unconditioned Space R-Value	N/A

Other Insulation R-Values

Window U-Factor	0.35	Window SHGC	0.32
Skylight U-Factor	0.48	Skylight SHGC	0.32
Gleazed Door U-Factor	0.38	Operable Doors (>50% glazed) U-Factor	N/A

Mechanical Information:

Water Heater Installed By: Randor Low Enterprises

Gas	X	Energy Factor	0.67
Electric		Energy Factor	
Other (Specify)		Efficiency	

Number of Heating & Cooling Systems: 1 (# of Air Handlers)

Heating Gas	Natural	AFUE	80	N/A
Air Source Heat Pump			HSPF	N/A
Heat (Other)	N/A		Efficiency	N/A

Cooling System Type: DX SEER 13

(Direct Expansion, Heat Pump, Geothermal, Etc.)

Total House Heating Load	30000	(Btu/h Based on ACCA Manual J, "R" or "I")
Total House Cooling Load	18000	(Btu/h Based on ACCA Manual J, "R" or "I")
Cooling Service Load	13800	(Btu/h) Cooling Load Limit: 14400 (Btu/h)
Total Air Handler CFM	570	(Based on Design Calculations)

Heating and Cooling Load Calculations Performed by Name: Kevin Chisholm

Georgia Residential Energy Code Compliance Certificate*

Builder/Design Professional: ABC Builder Phone: 404-123-4567

Envelope Summary:

- List the R-Value for the following components:

Flat ceiling/roof: <u>R-30</u>	Sloped/vault ceiling: <u>n/a</u>
Exterior wall: <u>R-13</u>	Above grade mass wall: <u>n/a</u>
Attic kneewall: <u>n/a</u>	Attic kneewall sheathing: <u>R18</u>
Basement stud wall: <u>n/a</u>	Basement continuous: <u>n/a</u>
Crawlspace stud wall: <u>n/a</u>	Crawlspace continuous: <u>n/a</u>
Foundation slab: <u>R-0</u>	Floors over unconditioned space: <u>R19</u>
Cantilevered Floor: <u>n/a</u>	Other insulation: <u>n/a</u>
- Fenestration Components:

Window U-factor: <u>0.32</u>	Window SHGC: <u>0.29</u>
Skylight U-factor: <u>n/a</u>	Skylight SHGC: <u>n/a</u>
Glazed Door U-factor: <u>n/a</u>	Opaque Door U-factor: <u>0.35</u>
	(<50% glazed)
- Building Envelope Tightness (BET):

BET test conducted by: Home Performance Smith Phone: 404-123-6547
 Fan Flow at 50 Pascals = 2,000 CFM₅₀ Total Conditioned Volume = 20,000 ft³
 ACH₅₀ = CFM₅₀ x 60 / Volume = 6 ACH₅₀ (must be less than 7 ACH₅₀)
 Low Rise Multifamily Visual Inspection Option
 (The visual inspection option may be conducted by a third-party instead of the BET test for R-2 buildings only.)
 Visual inspection conducted by: n/a Phone: n/a

Mechanical Summary:

Water Heater Energy Factor: 0.61 EF Fuel type: Gas Electric Other
 Number of Heating and Cooling Systems: 1
 Heating System Type (choose one):
 Gas: 90% AFUE Air-Source Heat Pump: _____ HSPF
 Other: _____ Efficiency: _____

Cooling System Type (Standard DX, Heat Pump, Geothermal, etc.): Standard DX
 Cooling System Efficiency: 13 SEER EER Other

Heating/Cooling Load Calculations Performed by: HVAC Smith Phone: 770-123-4567
 Total Heating Load (Based on ACCA Man. J or other approved methodology): 39,800 Btu/h
 Total Cooling Load (Based on ACCA Man. J or other approved methodology): 28,800 Btu/h
 Cooling Sensible Load: 20,800 Btu/h Cooling Latent Load: 8,000 Btu/h
 Total Air Handler CFM (based on design calculations): 1600 CFM
 Duct Tightness Test Conducted by: HVAC Smith Phone: 404-123-4567

CFM₂₅ per 100 ft² of conditioned floor area = CFM₂₅ x 100 / Conditioned floor area served
 If all ducts are not located within conditioned space, builder must verify that either the postconstruction duct leakage to outdoors (PCO) is ≤ 8 cfm/100 ft², the post construction total duct leakage (PCT) is ≤ 12 cfm/100 ft², or the rough-in test (RIT) with air handler installed is ≤ 6 cfm/100 ft². State which method was used to conduct the duct tightness test: duct blower (DB), modified blower door subtraction method (MBDS), or automated multipoint blower door (AMBD).

System	Method (DB, MBDS, AMBD)	Test (PCO, PCT, RIT)	CFM ₂₅	Area served (ft ²)	Test Result
1	<u>DB</u>	<u>PCT</u>	<u>100</u>	<u>2,000</u>	<u>5</u>
2					
3					

*Note: This permanent certificate shall be posted on or in the electrical distribution panel. Certificate shall be completed by the builder or registered design professional. Where there is more than one value for each component, certificate shall list the value covering the largest area.

Go to southface.org to download fillable pdf of this form!

Blower Door Results go here:

Load Calc Results go here:

Duct testing Results go here:

- Mandatory Requirement: Air Sealing
 - Detailed list
 - Fenestration
 - Fireplaces
 - Recessed light fixtures: airtight, IC-rated
- Details on techniques for air sealing – in flip book format



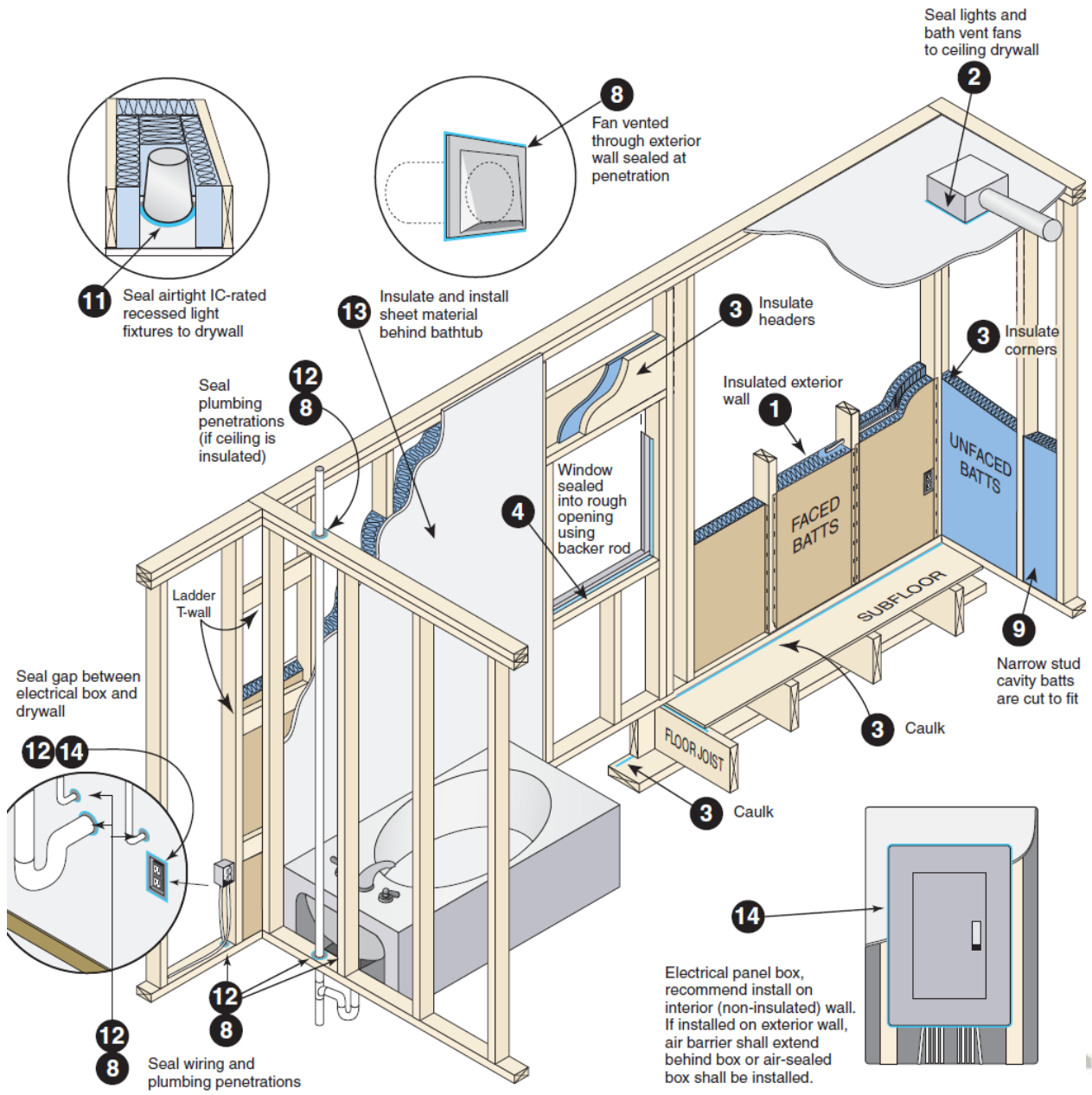
- New *wood-burning fireplaces shall have gasketed doors and outdoor combustion air
* *masonry site-built*



402.4.1.1 Air Barrier and Insulation Inspection

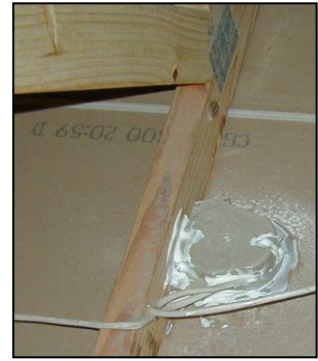
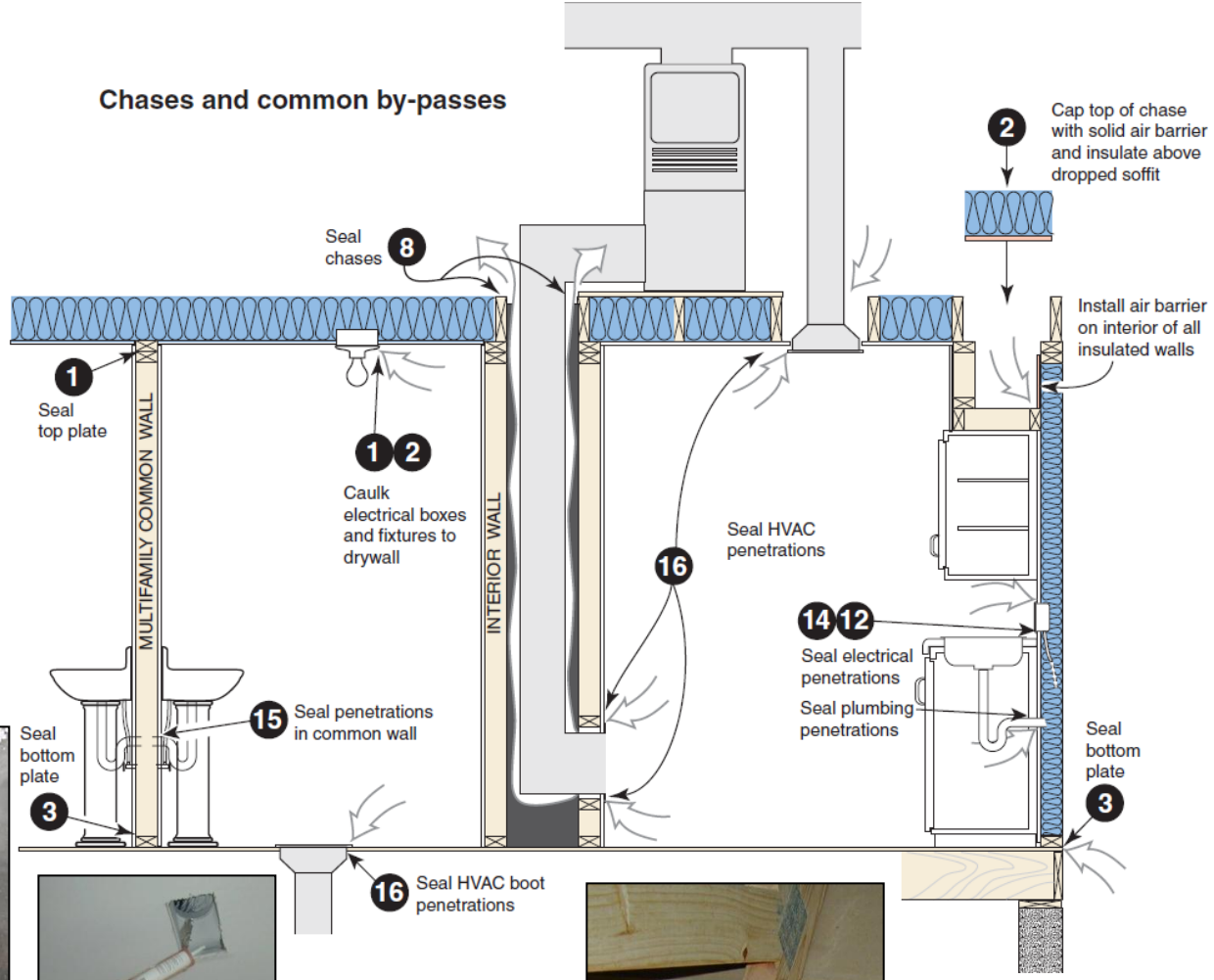
NUMBER	COMPONENT	CRITERIA
1	Air barrier and thermal barrier	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier. Breaks or joints in the air barrier are filled or repaired. Air-permeable insulation is not used as a sealing material. Air-permeable insulation is inside of an air barrier.
2	Ceiling/attic	Air barrier in any dropped ceiling/soffit is substantially aligned with insulation and any gaps are sealed. Attic access (except unvented attic), knee wall door, or drop down stair is sealed.
3	Walls	Comers and headers are insulated. Junction of foundation and sill plate is sealed.
4	Windows and doors	Space between window/door jambs and framing is sealed.
5	Rim joists	Rim joists are insulated and include an air barrier.
6	Floors (including above-garage and cantilevered floors)	Insulation is installed to maintain permanent contact with underside of subfloor decking. Air barrier is installed at any exposed edge of insulation.
7	Crawl space walls	Insulation is permanently attached to walls. Exposed earth in unvented crawl spaces is covered with Class I vapor retarder with overlapping joints taped.
8	Shafts, penetrations	Duct shafts, utility penetrations, knee walls and flue shafts opening to exterior or unconditioned space are sealed.
9	Narrow cavities	Batts in narrow cavities are cut to fit, or narrow cavities are filled by sprayed/blown insulation.
10	Garage separation	Air sealing is provided between the garage and conditioned spaces.
11	Recessed lighting	Recessed light fixtures are air tight, IC rated, and sealed to drywall. Exception—fixtures in conditioned space.
12	Plumbing and wiring	Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.
13	Shower/tub on exterior wall	Showers and tubs on exterior walls have insulation and an air barrier separating them from the exterior wall.
14	Electrical/phone box on exterior walls	Air barrier extends behind boxes or air sealed-type boxes are installed.
15	Common wall	Air barrier is installed in common wall between dwelling units.
16	HVAC register boots	HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.
17	Fireplace	Fireplace walls include an air barrier.

GA Appendix A - Air Sealing General (p.18) Southface

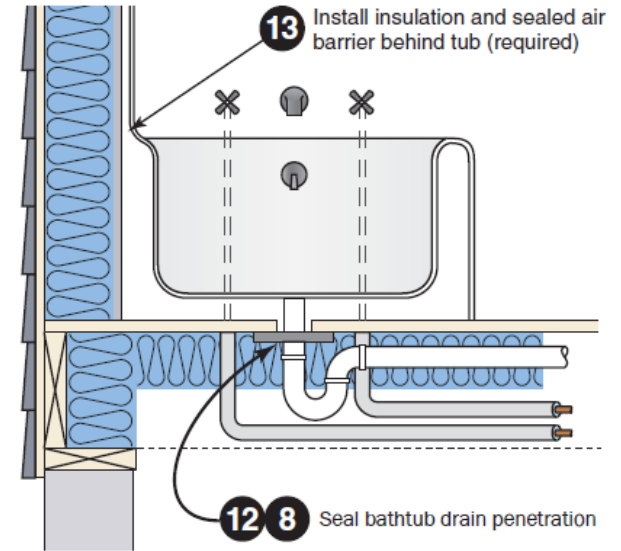




Chases and common by-passes

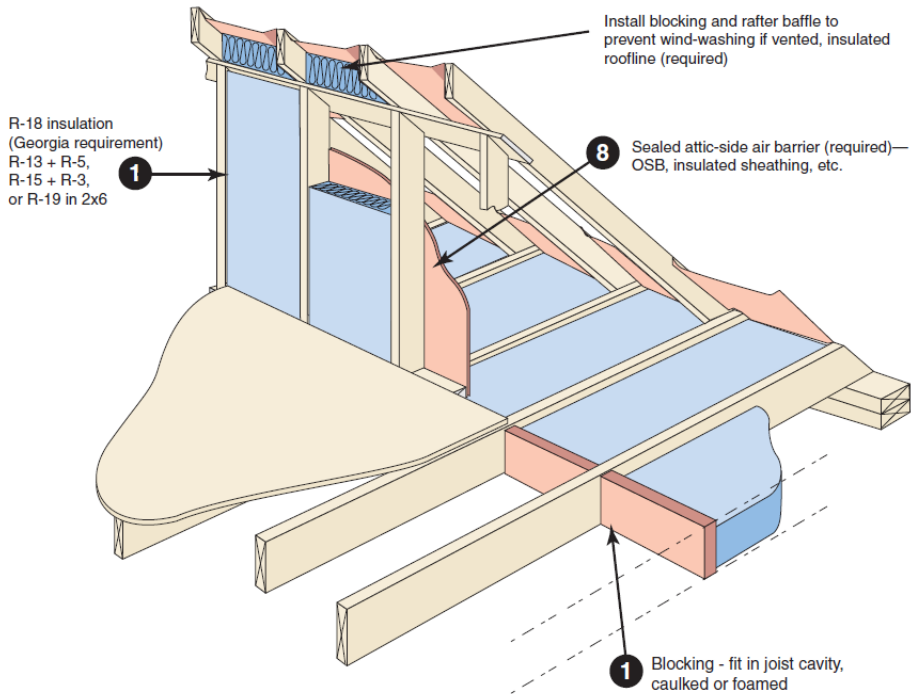


Solid sheet behind tubs & showers on insulated walls (p. 19)

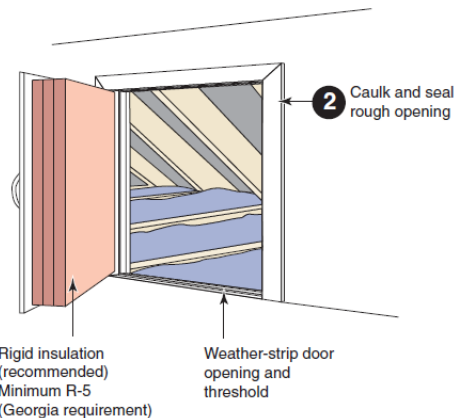


Call back waiting to occur

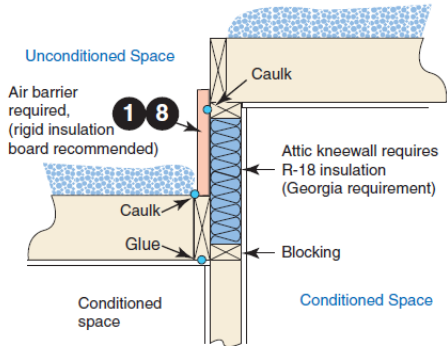
Call back prevention



Attic knee-walls



Two-level attic



- **REQUIRED Blower Door test**
 - CZ1-2 Test out at less than **5 ACH₅₀**
 - CZ 3-8 Test out at less than **3 ACH₅₀**

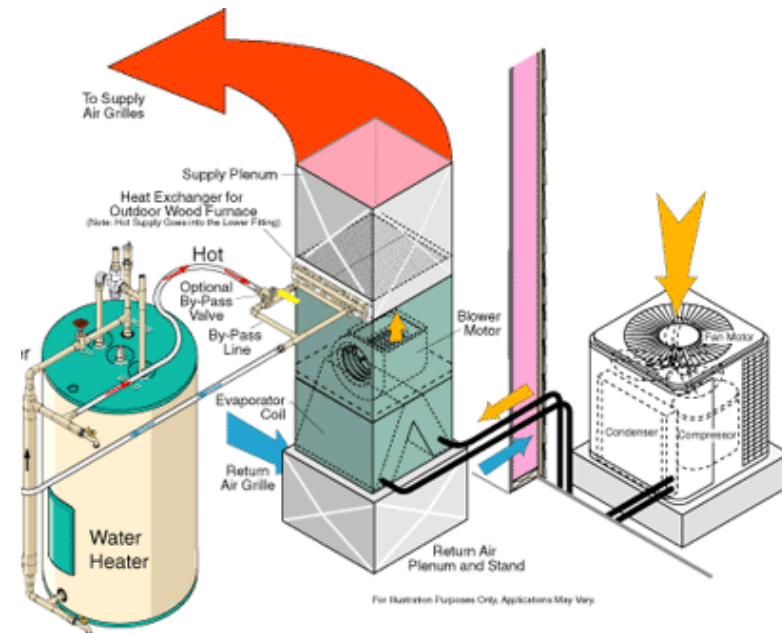


$$ACH_{50} = \frac{CFM_{50} \times 60}{Volume}$$

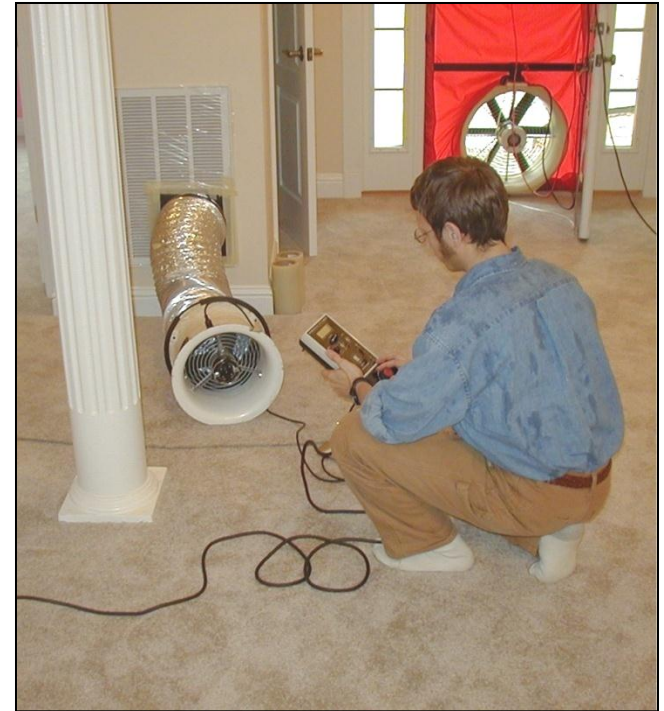
Section 403.1 - HVAC Controls

Mandatory Requirement:

- **Programmable** thermostat required for furnace
- Heat Pump requires smart thermostat or lockout feature to prevent unnecessary strip heat



- Duct Tightness Testing
REQUIRED by **DET Verifier**
 - When tested at rough-in
 - Maximum 4% Total Leakage with AHU installed
 - When tested at final
 - Maximum 4% – Total Leakage



GA: Blower Door and Duct Leakage test results
MUST be displayed on Certificate!

Mandatory Requirement:

- Insulation:
 - R-8 Insulation in Attic
 - R-6 Insulation other unconditioned space
 - No Insulation required when inside envelope
- May not use building cavities as supply or return
- **Sealing with Mastic required – “thick as a nickel” (GA specific)**

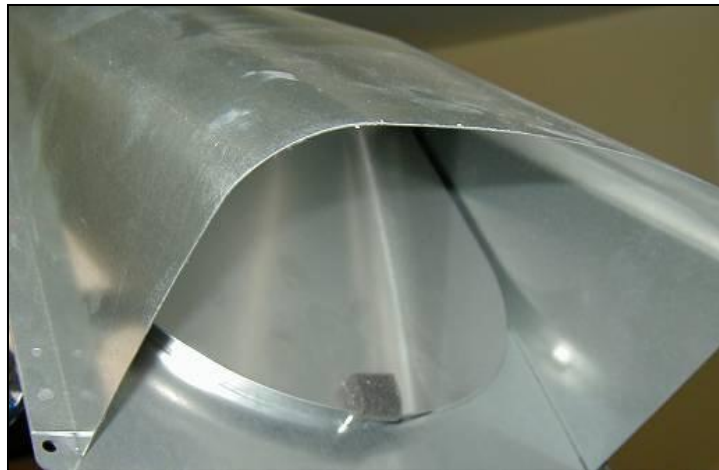


- Pipe Insulation
 - R-3: long list of new applications, must be weather proof
 - mechanical systems –
fluids > 105 F or < 55 F
- Controls for plumbing circulating systems



403.5 Ventilation

- Whole house ventilation system required
 - meet IMC or IRC
 - minimum efficacy
- Mechanical Vents
 - require dampers



403.6 Equipment Sizing

- Load Calcs & Sizing

Right-Suite Residential J8 - [Lanigan-Cape-Cod.rpt: Loads Worksheet]

File Edit View Show Drawing Options Window Help

Right-J8 Worksheet

1 Room name Entire House Basement z

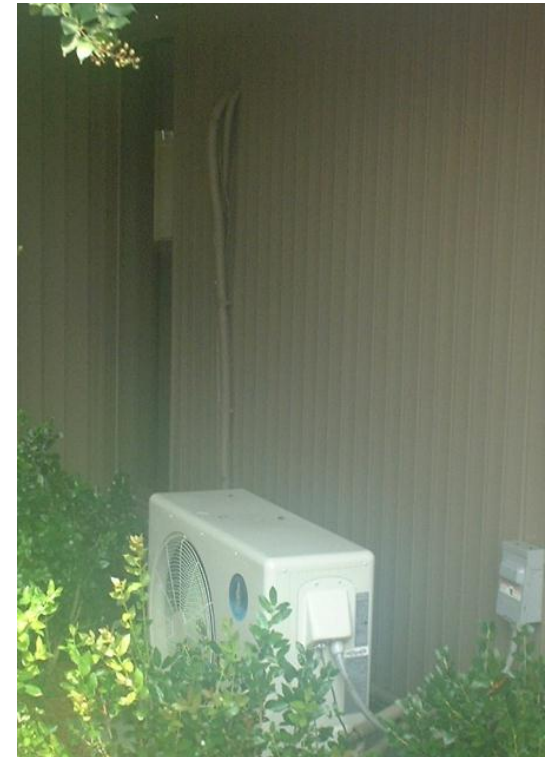
2 Exposed wall 172.0 ft 172.0 ft

3 Ceiling height 10.0 d 10.0 p

4 Room dimensions

5 Room area 1741.6 ft² 1741.6 ft²

Ty	Construction number Select any cell then click here	U-value	Or	HTM (Btuh/ft ²)		Area (ft ²) or perimeter (ft)		Load (Btuh)		Area (ft ²) or perimeter (ft)		Load (Btuh)	
				Heat	Cool	Gross	N/P/S	Heat	Cool	Gross	N/P/S	Heat	Cool
6	W 12C-6bw	0.060	ne	2.820	0.759	0	0	0	0	0	0	0	0
	W 15B-0c-6	0.488	ne	13.07	2.996	523	523	6834	1567	523	523	6834	658
	W 12C-6bw	0.060	se	2.820	0.759	0	0	0	0	0	0	0	0
	W 15B-0c-8	0.488	se	8.986	1.498	333	333	2992	499	333	333	2992	343
11	W 12C-6bw	0.060	sw	2.820	0.759	0	0	0	0	0	0	0	0
	W 15B-0c-6	0.488	sw	13.07	2.996	523	523	6834	1567	523	523	6834	1332
	W 12C-6bw	0.060	nw	2.820	0.759	333	209	588	158	333	209	588	132
	G 1D-c2ow	0.550	nw	25.85	34.40	83	0	2157	2871	83	0	2157	6231
	G 10B-w	0.600	nw	28.20	18.13	41	0	1156	743	41	0	1156	1482
	C 16B-28md	0.034	-	1.598	1.770	0	0	0	0	0	0	0	0
	F 22A-vpm	1.180	-	55.46	0.000	330	55	3050	0	330	55	3050	0
	F 21A-28t	0.022	-	1.034	0.000	1411	116	1459	0	1411	116	1459	0



403.9.1 Pool heaters

- Readily accessible on-off switch
- Natural gas or LPG fired pool heaters will not have continuously burning pilot lights

403.9.2 Time switches

- Automatic controls required to operate pool heaters and pumps on a preset schedule
- Exceptions
 - Where public health standards require 24 hour operation
 - Where pumps are required to operate solar and waste heat recovery pool heating systems



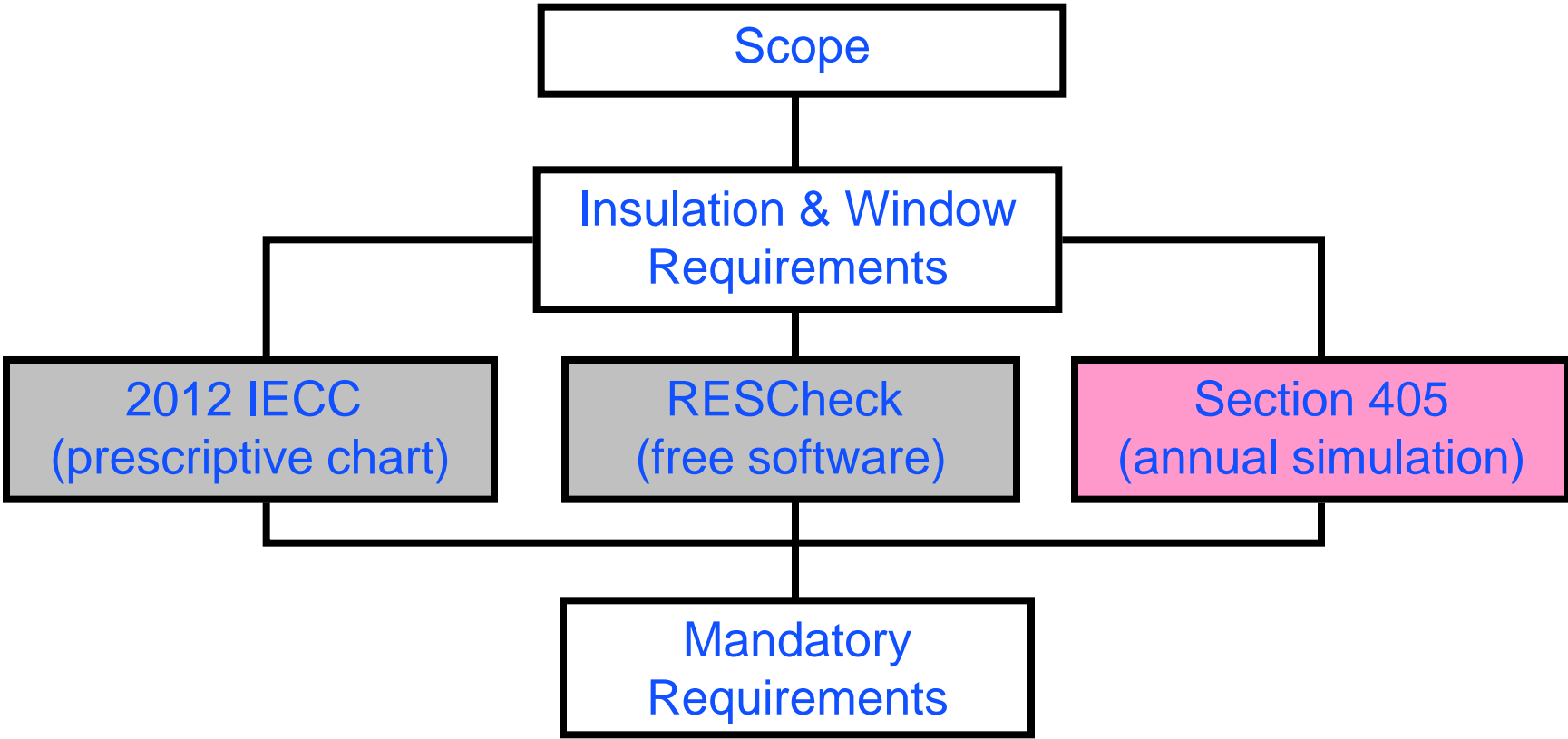
403.9.3 Pool Covers

- Heated pools required to have a pool cover
 - Pool cover must be vapor retardant
- Exception
 - Pools deriving $> 70\%$ energy for heating from site-recovered energy (heat pump) or solar source



- Residential
 - 75% of lamps in permanently installed fixtures shall be high efficacy lamps
 - 60 lumens per watt if over 40 W
 - 50 lumens per watt if between 40 and 15 W
 - 40 lumens per watt if 15 W less





Simulated Performance Alternative

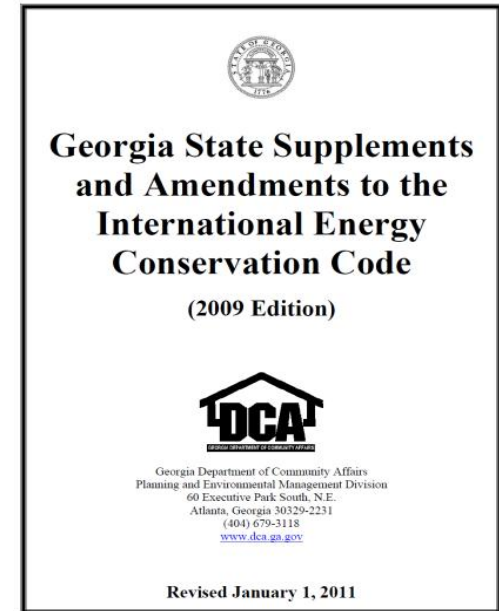
- Annual energy usage simulation demonstrates that the proposed building's *energy costs* are \leq “standard code” building
- Likely to involve a HERS rater
- REMrate, Energy Gauge, etc.
- Allow more flexibility (SHGC, duct R-value, etc.)

www.resnet.us



Ways we have made the code better

1. Improved Kneewalls
2. Consistent Windows
3. Air Sealing Graphics
4. Minimum Insulation Thresholds
5. Lighting Vacancy Sensor Credit
6. Better Ducts - Require Mastic
7. No Electric Furnaces
8. No Powered Attic Ventilators (except solar powered)
9. Mandatory Blower Door and Duct Blaster test
10. Qualifications of Verifiers— (who can do testing)



Certified DET Verifier can either:

- Be previously certified
 - HERS Rater
 - BPI Analyst
 - Home Performance with ENERGY STAR contractor
- Pass a DET Verifier Course
 - Explain calculations for ACH50 and % duct leakage
 - Discuss testing protocol (setup, safety, and accuracy)
 - Field exam on tools (use blower door and duct tester)
 - Pass Written Exam – 25 Questions (1 hour)



CERTIFIED DUCT AND ENVELOPE TIGHTNESS (DET) VERIFIER. A certified DET verifier shall be a certified Home Energy Rating Systems (HERS) rater, or be a certified Home Performance with ENERGY STAR contractor, or be a Building Performance Institute (BPI) Analyst, or successfully complete a certified DET verifier course that is approved by the Georgia Department of Community Affairs.
(Effective January 1, 2011)

Wrap up and Q&A

Thank you!

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www.energycodes.gov

